CLAIMS

What is claimed is:

1. A pump apparatus comprising:

an impeller;

a stator;

a plurality of permanent magnets forming bearing poles coupled to a selected one of the stator and the impeller; and

a plurality of shorted coils coupled to the other of the stator and the impeller, wherein the plurality of bearing poles and shorted coils co-operate to form an electrodynamic bearing during rotation of the impeller, wherein at least one of the stator and the impeller includes hydrodynamic bearing surfaces for generating a hydrodynamic bearing between the impeller and stator.

2. The apparatus of claim 1 wherein the plurality of permanent magnets is coupled to the stator and the plurality of shorted coils is carried by the impeller.

3. The apparatus of claim 1 wherein the plurality of permanent magnets is carried by the impeller and the plurality of shorted coils is coupled to the stator.

4. The apparatus of claim 1 wherein the electrodynamic bearing forms an axial bearing.

5. The apparatus of claim 1 wherein the electrodynamic bearing forms a radial bearing.

6. The apparatus of claim 1 wherein the hydrodynamic bearing forms a radial bearing.

7. The apparatus of claim 1 wherein the hydrodynamic bearing forms an axial bearing.

8. The apparatus of claim 1 wherein the plurality of permanent magnets comprises a plurality of distinct magnetic elements, each magnetic element corresponding to one of the bearing poles.

9. The apparatus of claim 8 wherein the individual magnetic elements form a Halbach array.

10. The apparatus of claim 1 wherein the plurality of permanent magnets is a single element comprising a plurality of distinct magnetic domains, each magnetic domain corresponding to one of the bearing poles.

11. The apparatus of claim 10 wherein the plurality of magnetic domains forms a Halbach array.

12. The apparatus of claim 1 wherein the stator further comprises a spindle about which the impeller rotates.

13. The apparatus of claim 1 wherein the impeller includes a plurality of tapered surfaces for generating the hydrodynamic bearing.

14. The apparatus of claim 1 wherein the pump apparatus further comprises a plurality of motor poles for driving the impeller, wherein the motor poles and bearing poles are distinct.

15. The apparatus of claim 14 wherein the number of bearing poles is distinct from the number of motor poles.

16. The apparatus of claim 1 wherein the plurality of permanent magnets also serve as motor poles for driving the impeller.

17. The apparatus of claim 1 wherein at least one bearing pole further comprises a plurality of permanent magnets.

18. The apparatus of claim 1, the pump apparatus further comprises a plurality of motor poles for driving the impeller, wherein each of the motor poles has an axis of magnetization substantially parallel to an axis of rotation of the impeller.

19. The apparatus of claim 1 wherein the pump apparatus further comprises a plurality of motor poles for driving the impeller, wherein each of the motor poles has an axis of magnetization substantially perpendicular to an axis of rotation of the impeller.

20. The apparatus of claim 1 wherein the pump apparatus is a selected one of an axial flow, a mixed-flow, and a centrifugal pump.